

# The 'Ecosystem' Approach to Managing Human Uses and Abuses of Natural Resources in the Great Lakes Basin

by

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## INTRODUCTION

The Great Lakes Basin of North America is a large, politically shared, mid-continent 'ecosystem'.† It covers an area of 750,000 km<sup>2</sup> and has a 2:1 surface ratio of land to water. Over the past 200 years, human population in the Basin has risen from about 300,000 with a demotechnic index (ratio of technological to physiological metabolism) of less than 2.0, to a population of 38 millions with a demotechnic index in the range of 80 to 100. This exponential growth has stressed both human and non-human parts (Beeton, 1965; Francis *et al.*, 1979; Burns, 1985) of the 'ecosystem'. In response, there has been a succession of increasingly integrative approaches to management. These have been characterized by Christie *et al.* (1986) as *ego-centric* (indifferent to environmental values), *piecemeal* (dealing with problems one by one), *environmental* (integrative management in respect of air, water, land, and living resources) and, most recently, as '*ecosystemic*' (involving, in this case, holistic management of a human-environment system).

The term '*ecosystem*' is used here to mean a subdivision of The Biosphere with boundaries which are arbitrarily defined according to some particular purpose or purposes in hand. Our primary focus is on the 'Great Lakes Basin Ecosystem',† which is defined in the Great Lakes Water Quality Agreement (1978) as: 'the interacting components of air, land, water, and living organisms, including man, within the drainage basin of the St. Lawrence River at or upstream from the point at which this River becomes the

international boundary between Canada and the United States.' *Ecosystem*, in contrast, refers to persons or organizations that are indifferent to, or unaware of, environmental influences on their behaviour.

'*Ecosystem approach*' means an integrated set of policies and managerial practices that relate people to 'ecosystems' of which they are part—rather than to external resources or environments with which they interact. The identifying characteristics include: *synthesis* (integrated knowledge); a *holistic perspective* interrelating systems at different levels of integration; and actions that are *ecological*, *anticipatory*, and *ethical* in respect of other systems of Nature (Christie *et al.*, 1986; Vallentyne & Hamilton, 1987).

The primary distinction between environmental and 'ecosystem' approaches depends on whether the system under consideration is external to (in the environmental approach) or contains (in the 'ecosystem' approach) the population under study. The conventional concept of environment is like that of *house*—external and detached; in contrast, 'ecosystem' implies *home*—something that we feel part of and see ourselves in—even when not there (Christie *et al.*, 1986). The shift from an environmental to an 'ecosystemic' point of view is actually quite radical. It calls for a change in the entire field within which opportunities and problems are examined—a change from a view of environment in a political or people-oriented context to a view of politics in an 'ecosystem' context.

Fig. 1 shows the past, present, and possible future, states of development of management approaches in the Great Lakes Basin over a 100-years' interval for the 12 problem areas that were listed by Vallentyne & Hamilton (1987). The positions of the bars could be debated; however, few would contest the general trends.

In the present paper we examine the characteristics, potential, and current development, of the 'ecosystem' approach to planning, research, and management, that is evolving in the Great Lakes Basin under the Canada-United States International Joint Commission (IJC). The IJC is made up of six persons, three from Canada and three

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† The 'Great Lakes Basin Ecosystem' (*sic*) is defined in the Canada-United States 'Great Lakes Water Quality Agreement' of 1978 (see below and cf. References) but involves a very different and far wider use of the term 'ecosystem' than our usual, 'classical' one employed for example in Polunin (1986) and, in the plural implying relative narrowness, in earlier drafts of the present paper.—Ed.

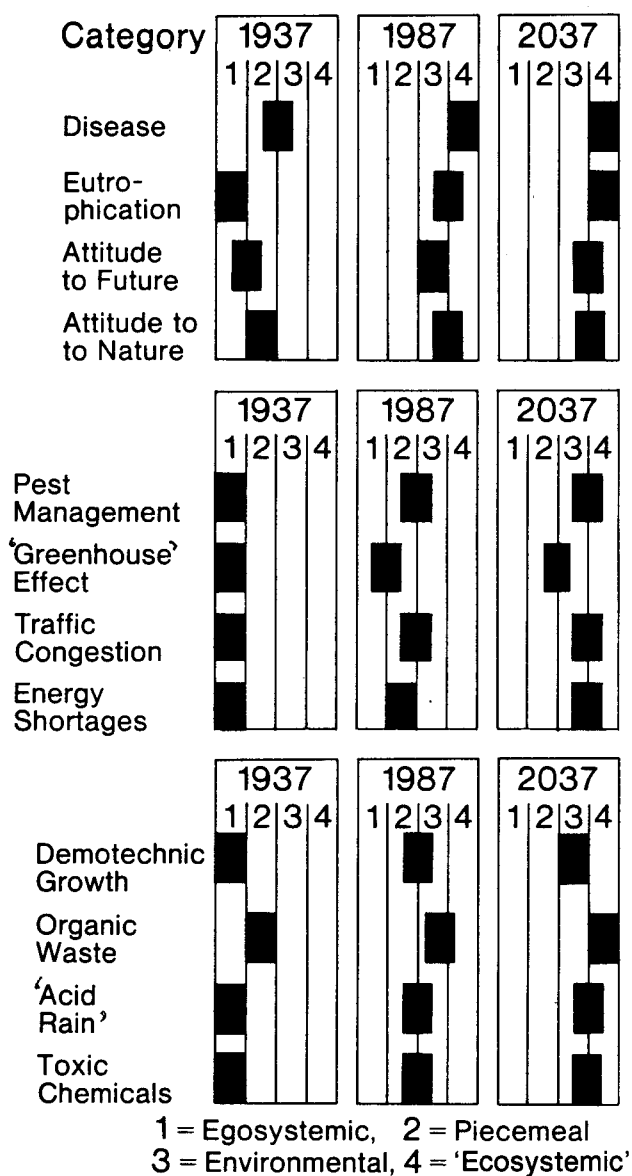


FIG. 1. Comparison of management approaches (egosystemic, piecemeal, environmental, 'ecosystemic') in 1937, 1987, and 2037 (predicted) for the twelve categories of 'ecosystem' problems identified by Vallentyne & Hamilton (1987).

from the United States, appointed under the terms of the Boundary Waters Treaty of 1909, to examine, jointly, issues where actions on one side of the border result, or seem at all likely to result, in injury to health or property on the other side of the border.

The development of an 'ecosystem' approach is not unique to the Great Lakes Basin (e.g. Caldwell, 1970a, 1970b; Moran, 1984; Polunin, 1986). It is merely that institutional arrangements there have permitted it to be more fully expressed than in most other parts of the world. The case examined here is of general interest in respect to managing the human uses and abuses of shared resources, including those of The Biosphere as a whole.

#### DEVELOPMENT OF AN 'ECOSYSTEM' APPROACH IN THE BASIN

When environmental problems came into prominence in North America in the 1960s, the question was how to deal with them politically—meaning governmentally and, ultimately, in practical ways. *Environment* seemed to imply 'everything' at the time; yet, a department of 'everything' within government was unthinkable. The solution adopted by most governments was to create environmental agencies with mandates that were commonly limited to renewable resources. This raised the political profile of environmental concerns by providing an integrative operational framework; however, it failed to deal systemically with the integration of the complex of social, economic, and 'green', environmental concerns. Consequently, new problems began to emerge with which an environmental approach could not adequately cope—for example, rising unemployment, disruptions in energy supplies and prices, and contamination of human food-chains with toxic industrial chemicals.

About this time the IJC was examining the extent, causes, and control, of pollution in the lower Great Lakes under a 1964 'reference' from the Governments of the United States and Canada. In its final report under the reference the IJC (1971) recommended that a new binational institutional mechanism be established to deal with pollution problems in the Great Lakes Basin. This led directly to the Great Lakes Water Quality Agreement of 1972, which established a joint institutional framework for setting water quality objectives, standards, monitoring procedures, and programmes, to attain the stated objectives. The IJC was identified as the organization responsible for collecting and analysing the information on programmes, and for verification of pertinent data. A Great Lakes Regional Office was established to assist the IJC, and two new boards were established under the 1972 Agreement—a Great Lakes Water Quality Board (jurisdictional) and a Great Lakes Research Advisory Board (scientific).

Between 1972 and 1978, many environmental studies were conducted by universities, industries, private consultants, and state, provincial, or federal, agencies. These laid the basis for improvements in understanding dynamic interactions among physical, chemical, biological, and social, systems. Under the terms of the 1972 Agreement, new pollution-control facilities were installed for the removal of organic substances and phosphorus at sewage treatment plants. Legislation was introduced to limit the permitted phosphorus content of heavy-duty laundry detergents. Gradually, evidence began to accumulate of a reversal of deteriorating water-quality trends in Lakes Erie and Ontario, and in the highly eutrophic waters of Green Bay (Lake Michigan) and Saginaw Bay (Lake Huron). On the other hand, control of toxic substances and diffuse sources of pollution proved more difficult. With improved techniques of detection, new contaminants were discovered in fish (e.g. Mirex, Toxaphene, dioxins, and dibenzofurans). It became obvious that a more integrated approach to management was needed than currently prevailed; water quality was not enough.

Lee, Regier & Rapport (1982) identified ten 'ecosystem' approaches that emerged in the Great Lakes Basin in the

1970s. These were all characterized by: (a) a primarily ecological focus, (b) an emphasis on connectivity, (c) a perception of 'ecosystems' as being self-regulating yet ultimately limited in recovery capability, and (d) a combination of reductionistic and holistic techniques. The units of management ranged from bays, lakes, and urban areas, to the Great Lakes Basin as a whole. The accents ranged from policy to strategy, tactics, and management tools.

One of these approaches was the basin-wide 'ecosystem' approach proposed on 20 July 1978 by the IJC Great Lakes Research Advisory Board (Great Lakes Research Advisory Board, 1978) and under discussion here. Significantly, two other events came to a head at the same time. These were: the final report of a six-years' study of diffuse sources of pollution by the IJC International Reference Group on Pollution from Land Use Activities (1978), and official designation by the New York State Commissioner of Health of the site of the Love Canal in Niagara Falls, N.Y., as a hazard to human health. To what extent the timing of these events, all of which took place within a two-weeks' period, may have influenced the Governments of Canada and the United States, is conjectural; in any event, elements of the 'ecosystem' approach advocated by the Great Lakes Research Advisory Board (1978) were incorporated into the Great Lakes Water Quality Agreement, which was signed on 22 October 1978.

According to the International Joint Commission (1984), the Great Lakes Water Quality Agreement of 1978 is 'a milestone document, one of the first international statements that technical, diplomatic and administrative approaches to resource management need to be considered in terms of holistic ecological concepts.' In terms of international law, Caldwell (in press) considers the 1978 Agreement to be of at least equal significance to, and possibly even greater importance than, the Boundary Waters Treaty of 1909. A review of the 1978 Agreement by the National Research Council of the United States and the Royal Society of Canada (1985), cited the 1978 Agreement as the beginning of an evolving process of 'ecosystem' management. Most significantly, the recent 1987 Agreement retained the basic framework of the 1978 Agreement, modifying only the particulars.

There is now a general consensus, among organizations with Basin-wide interests, of the necessity of an 'ecosystem' approach to reducing the incidence of our self-made problems. These organizations include the International Joint Commission, the Great Lakes Fishery Commission, The Council of Great Lakes Governors, the International Association for Great Lakes Research, Great Lakes Tomorrow, The Center for the Great Lakes, Great Lakes United (a consortium of environmental groups), and others. Significantly, the need for an 'ecosystem' approach has also been identified in Remedial Action Plans under preparation in 42 localized IJC 'Areas of Concern' in the Basin.

On the other hand, without undermining the significance of this conceptual support, the plain fact is that no new administrative mechanisms have been instituted to facilitate implementation of an 'ecosystem' approach in the Basin (Caldwell, in press; Thomas *et al.*, in press). The reason for this is not hard to find: the notion of an 'ecosystem' approach calls for an inversion of the order of priority of the great systems of power on which human

societies depend (Commoner, 1976). In governance, the flow of power proceeds downwards from political systems to economic systems and thence to technological production systems and finally to natural resource systems. In ecological theory the perceived flow of power (i.e. of available energy) is just the reverse: from natural resource systems to technological production systems and thence to economic systems and finally to political systems. The question is, therefore, not *why* progress in implementing an 'ecosystem' approach has been slow, but *how to account* for the development of an 'ecosystem' approach among others than environmentally-minded scientists in the first place.

#### WHY THE GREAT LAKES BASIN?

The following factors were significant in paving the way for development of an 'ecosystem' approach in the Great Lakes Basin in the 1970s:

- a large, highly valued, politically shared, natural resource (the Great Lakes);
- the long residence-times of 'conservative' pollutants in the Lakes (the time for 90% removal of conservative pollutants ranges from 9–10 years for Lake Erie to 500–600 years for Lake Superior);
- the Lakes are a drinking-water supply for some 23 million people;
- common enemies in the form of ecosystems that give rise to internal and external threats (e.g. pollution and proposed water diversions), which are threats to the quality and flow of that shared resource;
- advances in ecosystem theory (Tansley, 1935; Odum, 1971; Great Lakes Research Advisory Board, 1978; Golley, 1984; Polunin, 1986) and in knowledge of and attention to The Biosphere as a whole (Vernadsky, 1926, 1945; Caldwell, 1972; Anon., 1982; Pauling *et al.*, 1982; Polunin, 1972, 1982, 1984; Speth, 1984; Vallentyne, 1984, 1986);
- a rise in the number and interactions of voluntary membership associations at local, regional, and global, levels—the 'art of association' described by Tocqueville (1969);
- institutional arrangements providing fora for joint advice and administrative actions on shared resources (primarily the Boundary Waters Treaty of 1909 and the Great Lakes Water Quality Agreements of 1972, 1978, and 1987);
- common economic ties and similar cultural heritages of the people living in the Great Lakes Basin.

Collectively, these factors provided the systemic, institutional, and motivational, bases for joint action to restore and enhance the waters of the 'Great Lakes Basin Ecosystem.'\*

#### THE NEXT STEP

Caldwell (in press) identifies six possible future courses of action in implementing an 'ecosystem' approach in the Great Lakes Basin. These range from incremental improvements (making the present overall system work better

\* See second footnote on page 58.—Ed.

than it does at present) to a transnational organization with autonomous powers of decision-making and a right to taxation. At the same time, Caldwell also notes that, whatever measures are implemented, they 'must find a way around the hard reef of reality which is that the basin-wide ecosystem approach is inconsistent with traditional assumptions, attitudes and institutions prevailing in the jurisdictions surrounding the Great Lakes and in the two federal republics [nations] with primary jurisdiction over the region.'

This latter point is crucial. We cannot conceive of any way in which an 'ecosystem' approach could be implemented in jurisdictions with opposing attitudes, institutions, laws, and behaviours—except perhaps in an altruistic spirit of dedicated cooperation. In order for an 'ecosystem' approach to be implemented in any major politically-shared area, it is axiomatic that the cooperating governments should practice an 'ecosystem' approach within their own, larger, unshared territories. The advantages are likely to be appreciable in terms of human health, economic vitality, resource utilization, and sustainability.

On a global level, the ultimate solution to problems such as persistent toxic chemicals, destruction of tropical rainforests, extinction of species, global climatic change, acid precipitation, and depletion of the ozone layer, rests on the designation of nations as politically defined 'ecosystems' (subdivisions of The Biosphere) to be managed internally for citizens and externally to safeguard the health and well-being of The Biosphere as a whole. This is, in fact, the rationale for the United Nations system and the World Conservation Strategy. While such a view might seem visionary to political analysts, it actually calls for little more (though on a larger scale) than is already in action in the Great Lakes Basin under the Boundary Waters Treaty of 1909 and the Great Lakes Water Quality Agreement of 1978. Globally, a first step might be to detail national interests and obligations in respect to The Biosphere in the preambles of national constitutions. This could set the ground for 'reconstruction of The Biosphere in the interest of freely-thinking humanity as a single totality' (Vernadsky, 1945).

The way in which global implementation of an 'ecosystem' approach might come about, could be the same as in the Great Lakes Basin—through public perception of threats to some major, vitally important, shared resource. On a global level, threats to the atmosphere or contaminated food could be prime contenders. The threats are already on the horizon from carbon dioxide and other gases affecting global climate, from 'freons', from toxic industrial chemicals, and from radionuclides.

Of the eight conditions (see above) which are permissive to the development of an 'ecosystem' approach in the Great Lakes Basin, seven (including the economic and evolutionary ties that link members of our species) are on hand for The Biosphere as a whole. The only missing condition is *institutional arrangements*. Globally, the onus is on national governments to create the political frameworks for managing their ecosystems etc. in a Biospherical context.

The World Commission on Environment and Development (1985, 1987; see also Brundtland, 1987) has clearly identified the need for policy instruments linking ecology and economics, based on 'built-ins' rather than 'add-ons.'

There is also a need to complement the current reductionistic, 'top-down' system of environmental education with a new holistic, 'bottom-up' 'ecosystem' education beginning with parents at the time of marriage and continuing with their children.

The future evolution of 'ecosystem' approaches may depend on the combined will of people, expressed through voluntary membership organizations (Tocqueville, 1969), to spur governments to action. Initiatives, with rewards at both local and global levels, will be necessary to create and maintain supportive networks (Caldwell, 1972). Ecosystems will be the common enemy. Disasters will be the integrators and incipient instruments of change.

#### SUMMARY

An approach to planning, research, and management, that relates people to ecosystems of which they are part, is described and related to the Canada-United States Great Lakes Water Quality Agreements of 1972, 1978, and 1987. Factors favouring the development of an 'ecosystem approach' in the Great Lakes Basin include: a shared, highly valued resource; the long residence-times of 'conservative' pollutants in the Lakes; use of the Lakes for drinking-water supplies by c. 23 million people; threats to the integrity of the Lakes (pollution, water diversion); advances in ecosystem theory; the rise of voluntary membership associations with interests in the resource; institutional arrangements for managing nationally shared resources; and common economic ties and cultural heritages.

The principal obstacle to implementation of an 'ecosystem' approach in the Great Lakes Basin is the lack of policies for comparable approaches in the political jurisdictions surrounding the Great Lakes. The principal obstacle to global implementation of an 'ecosystem' approach is the lack of international institutional arrangements for joint advice and operational capabilities in respect of the management of nationally shared resources. Another impediment is the widespread egocentricity of governments, corporations, individuals, and the general public.

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